Hurricane Harvey

Clean Rivers Program Impact

Lessons Learned from Laboratory Flooding

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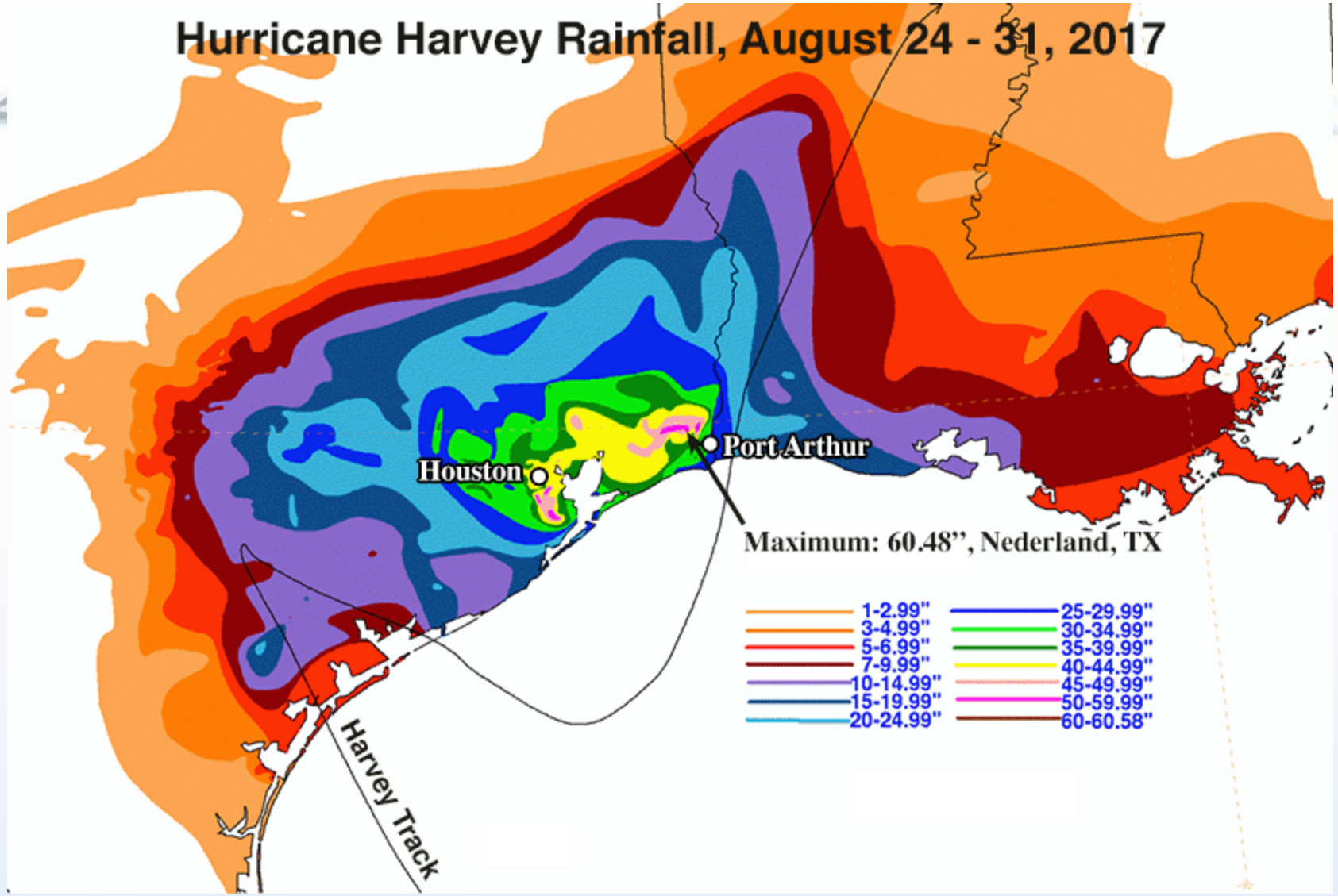
General Information

Hurricane Harvey Overview

General Information

- Significantly more info is available online
  - Wikipedia, RedCross, Weather.GoV, etc
- Brief Information
  - Struck Texas on August 24, 2017
    - Stalled, dumped rain, went back to sea
  - Struck Louisiana on August 29, 2017
    - Stalled, dumped rain, finally drifted inland
  - Some estimates of rainfall are >20 TRILLION gallons


Hurricane Harvey Rainfall, August 24 - 31, 2017
Houston
Port Arthur
Maximum: 60.48", Nederland, TX
1-2.99"
3-4.99"
5-6.99"
7-9.99"
10-14.99"
15-19.99"
20-24.99"
25-29.99"
30-34.99"
35-39.99"
40-44.99"
45-49.99"
50-59.99"
60-60.58"
Harvey Track

General Information

- Effect on Texans
  - 13,000 rescued
  - 30,000 left homeless
  - 185,000 homes damaged
  - 336,000 lost electricity
  - >$100,000,000,000 in revenue lost
- Areas of Houston received flooding that exceeded the 100,000 year flood estimates

General Information

- On the plus side…
  - 17% spike in births 9 months after Harvey
  - Unprecedented real-world drainage modeling
  - Significant future construction needs identified
    - IH-10 and many feeder highways already being altered to account for high(er) rainfall events
    - Many homes being built even higher, above normal 100y and 500Y flood plains

River Basin Impact

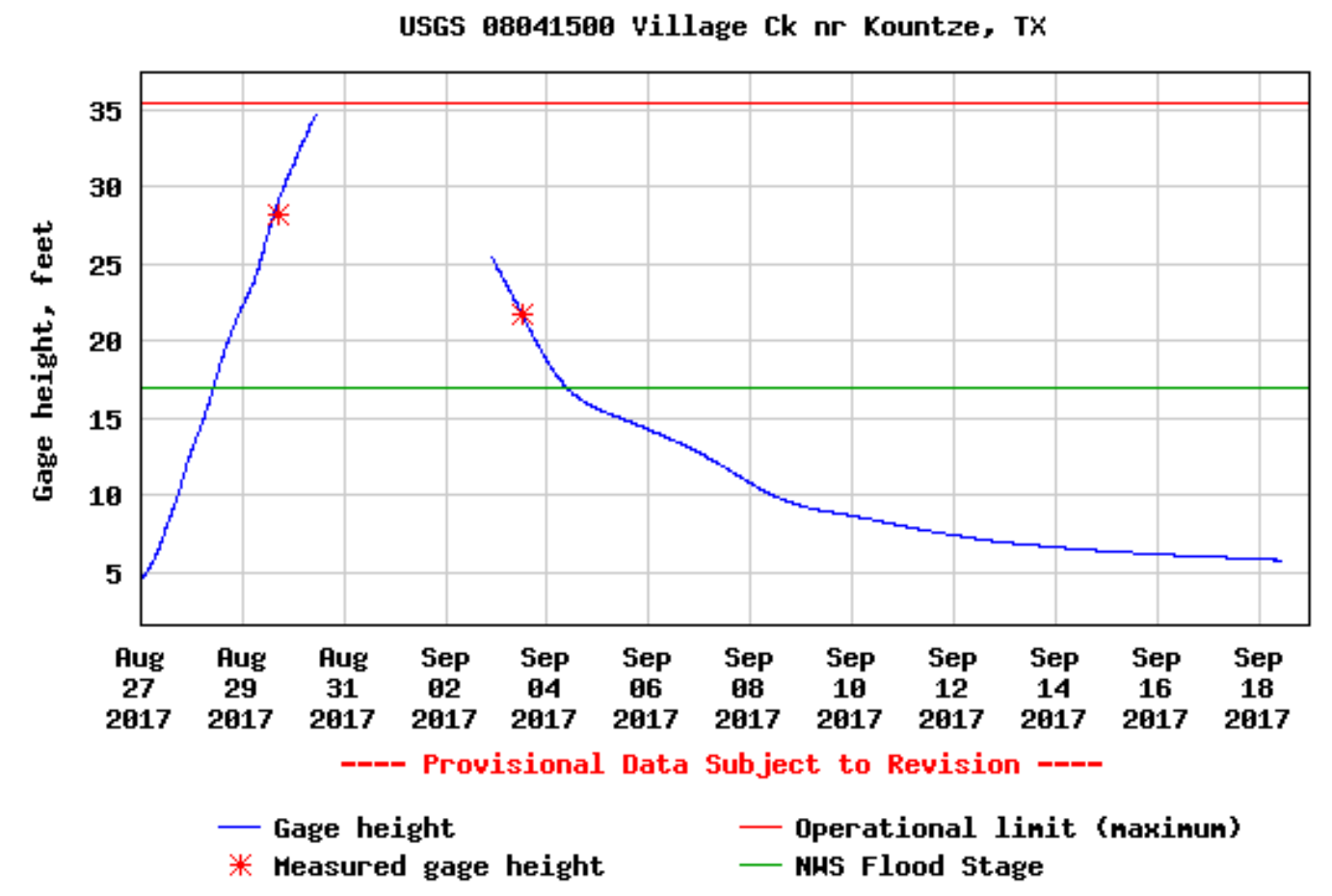
Lower Neches River and surrounding areas

River Basin Impact

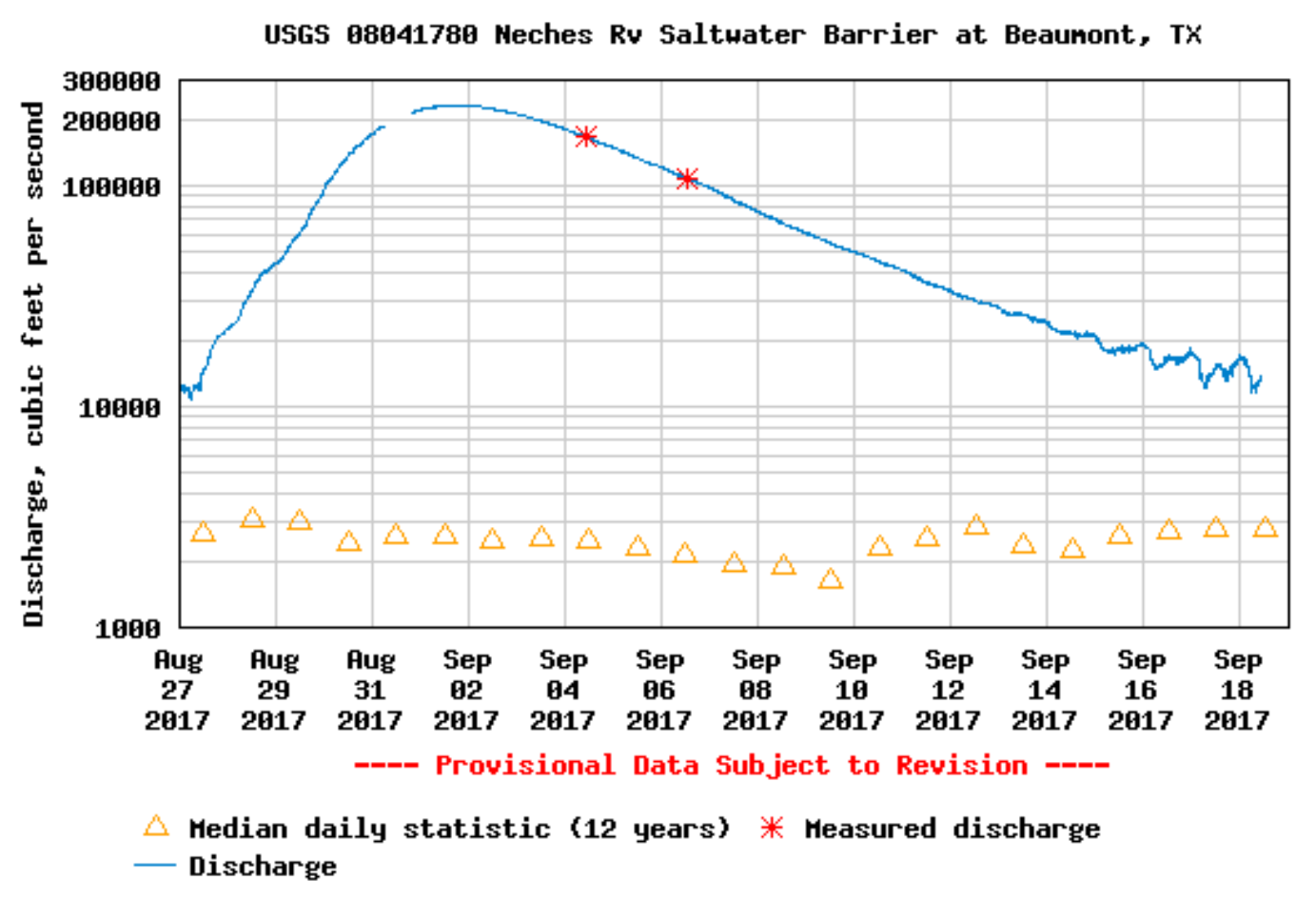
- Downed trees
  - Providing habitat for fish and ecotone species
- Trash
  - Still finding debris and trash miles inland and tens of feet up in trees
    - And bones
- Oil spills
  - Still investigating, but likely will not see impact

River Basin Impact

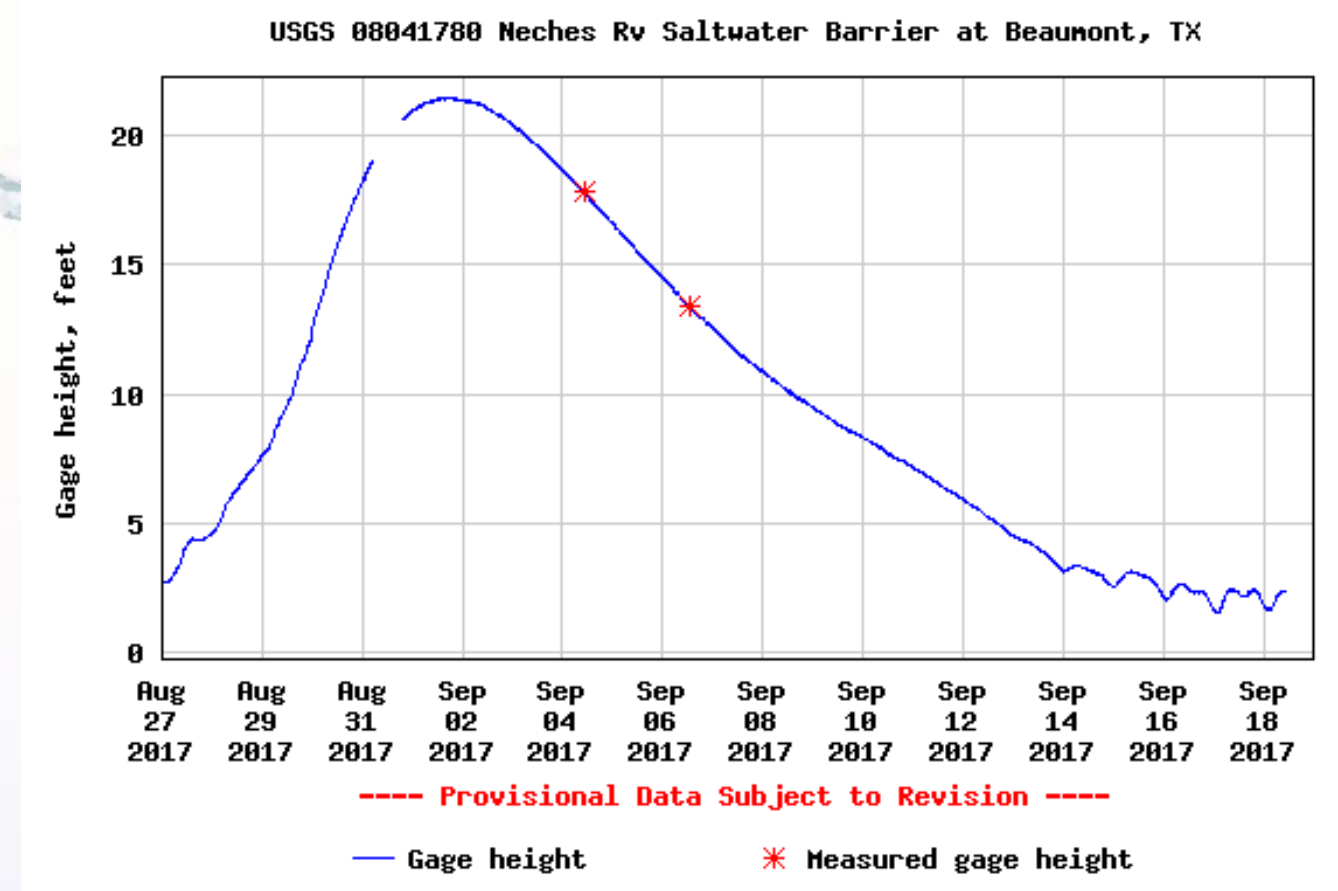
- The region is used to normal, seasonal flooding
- most plants and wildlife are adapted to it
- Humans are likely the only species really impacted
  - And their domestic partners



Village Creek, one of the tributaries of the Neches River, had a discharge comparable to that of the Niagra River (i.e. Niagra Falls).



The Mississippi River's discharge is close to 600,000 CFS. At the peak of the flood, it is estimated that the Neches River was pushing half that value. Normal discharge of the Neches is around 2,500CFS. Flow data above is a USGS estimate – all gauges were submerged.



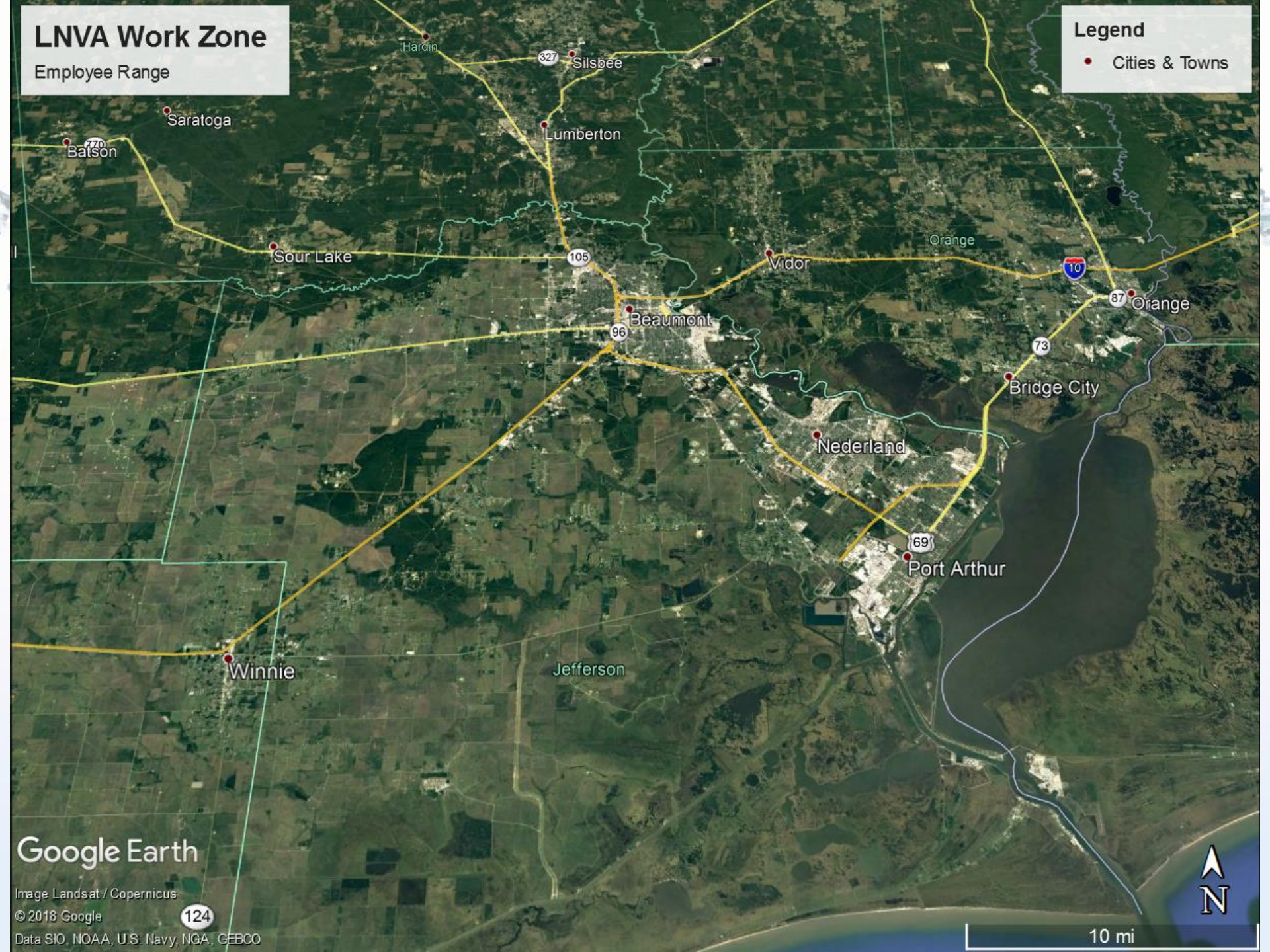
The saltwater barrier was built at the 500y flood stage, with the floor of the building at 18ft above sea level.

Community Impact

Greater Golder Triangle Area

LNVA Community Impact

- Many towns became islands during the flooding
- No food or trucks replaced market shelves
  - Market shelves were bare after only days
  - Typical cities have only 3 days' stock of food on hand
  - No medicines were available
- 88% of Orange County's 2010 census was flooded


LNVA Work Zone
Employee Range
Legend
Cities & Towns
Hardin
327
Silsbee
Saratoga
Lumberton
770
Batson
Sour Lake
105
Vidor
Orange
10
87
Orange
Beaumont
96
73
Bridge City
Nederland
69
Port Arthur
Winnie
Jefferson
124
Google Earth
Image Landsat / Copernicus
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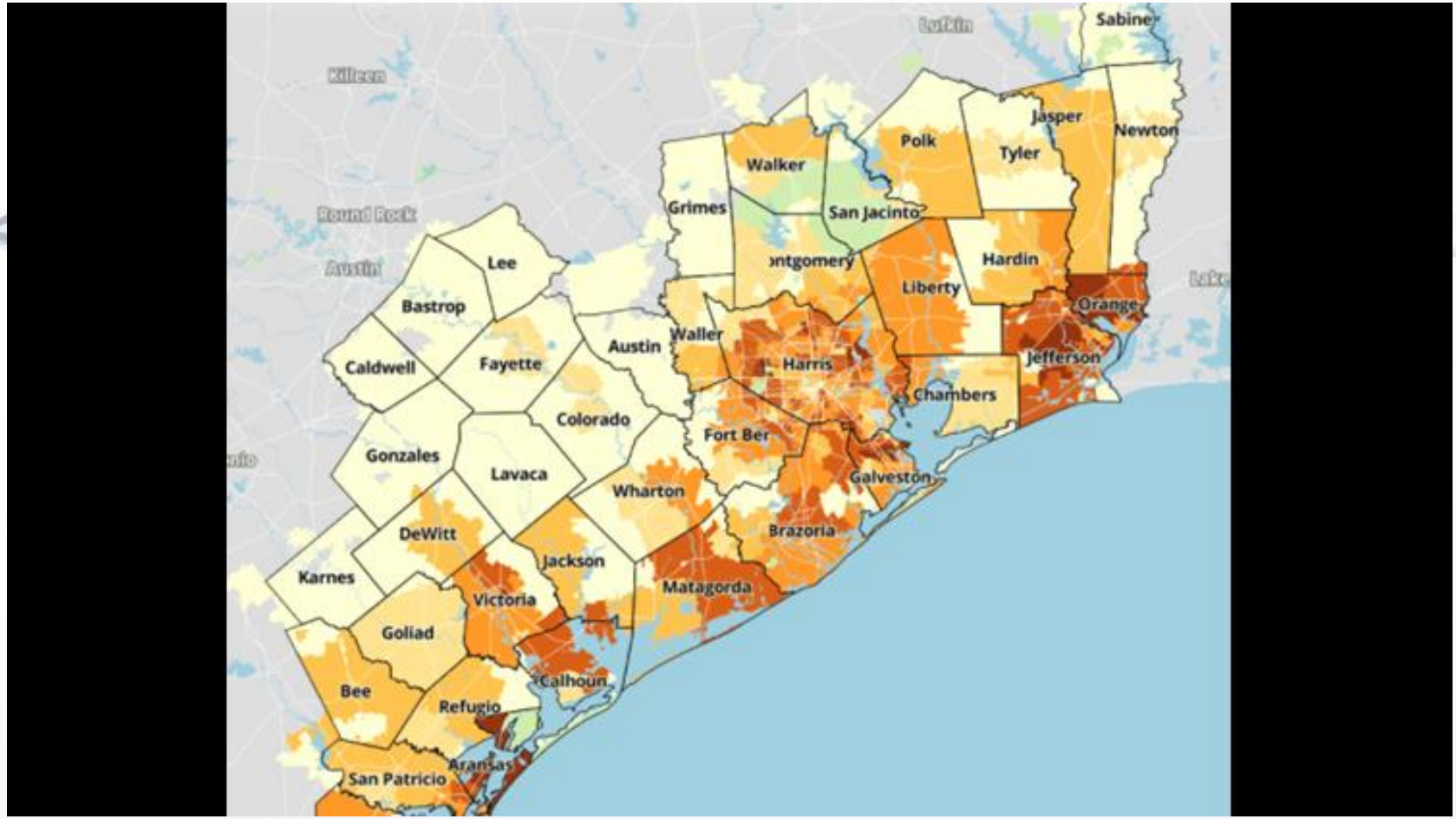
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
10 mi


Bevil Oaks
LNVA Saltwater Barrier
Nederland, TX
Kountze
Silsbee
Evadale
Saratoga
Batson
Lumberton
Deweyville
Rose Hill Acres
Texla
Mauriceville
Pine Forest
Bevil Oaks
Grayburg
Vidor
Rose City
Orange
Beaumont
China
Nome
Devers
Bridge City
Port Neches
Nederland
Groves
Fannett
La Belle
Port Arthur
Hamshire
Winnie
Stowell
Monroe City
Sabine Lake
JD Murphree Wildlife Management Area
McFaddin National Wildlife Refuge
Anahuac National



Jefferson and Orange Counties were hit by a storm surge of salt water during Hurricane Ike in 2008. The freshwater flood of 2017 added insult to injury for many. As of NOV2017, FEMA had over 880,000 applications for assistance (application density map shown above).

Sections of IH 10 from Louisiana to Houston were passable only by boat.

Water is denser than oil, so all lubricants and fuels were displaced to the surface of the flood. Machines had to be torn down to the bearings and reassembled before use.
The water in this image is 17ft above the ground.

Levees and overpasses sloughed due to flooding, contributing to damage.

The National Guard and the Cajun Navy were able to rescue thousands of people, but livestock were particularly impacted. Horses, in particular, were hard hit.

The marina was hit hard, with some boats damaging the marina – and other boats damaged by the marina.

Kountz, Texas, after the skies cleared following Hurricane Harvey.

Village Creek near Lumberton, TX. The nearest bridge physically washed out in places.

The fish caught in the fence is a two foot long gar.

Some flooding in the region is normal.

The residents of Bevil Oaks (near Pine Island Bayou) are used to it.

The blue line, however, represents Hurricane Harvey.

LNVA Community Impact

- Many homes still under reconstruction
- Those without flood insurance are having to pay as they earn
- Laborers are still in short supply
- Cabinet makers still back-ordered several months
- Plumbers still back-logged for parts as well as time
- Housing market in rough shape
- Many skilled workers have left due to Ike + Harvey

LNVA Laboratory Impact

Saltwater Barrier and Laboratory

LNVA Lab Impact

- Flooding took the laboratory server
  - Only a month's worth of data lost
- All hard copies of data and records lost
  - Except for 10 books that were up on a high shelf
- All electronic scientific devices flooded

Image at Left is the most recent image of the barrier. Image at right is the LNVA saltwater barrier during Hurricane Harvey.

This image was taken after the storm had passed and the flood waters had begun to recede.


Harvey Line: >21ft
Gage Board: 2’8”
SLOW
NO WAKE


Water Line

Entering the lab post-Harvey was done with a bit of trepidation.
Some of these are acids with a pH less than zero.


125 ml
PYREX

LNVA SWB lab before Hurricane Harvey

LNVA SWB Lab after Hurricane Harvey (late September 2017)

LNVA SWB lab, completely restored by April, 2018.

Lessons Learned

Physically and Digitally

Lessons Learned

- Go digital
  - Have cloud or off-site backups
  - CamScanner and other apps are a must
    - Batch chain of custodies, samples, field sheets
    - Bench books, cal logs, reagents books
    - Sonde maintenance books, C.A.R., etc
- Have supplies before disaster strikes
  - Week's worth of food and water, minimum
  - Many Beaumont locals get nervous if fuel tanks are below half

Lessons Learned

- Consider mobility of equipment
  - Setting high-value instruments higher would have saved them
  - Evacuating portable readers (such as Hach devices) would have been easy
- ***Really*** plan for the worst
  - Assume facility will be *gone* -- and all paper copies with it
  - Have inventories in digital form, off site, and backed up regularly
  - Take pictures of every piece of equipment, before *and* after
    - i.e. have regular inventory updates, pictures, S/Ns, order #'s, etc

Be Prepared.

Thank you for your time.